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ac-dc power supplies

BEHLMAN-INVAR ELECTRONICS CORP.
1723 CLOVERFIELD BLVD.
SANTA MONICA, CALIF.

REPRESENTATIVES IN ALL PRINCIPAL CITIES AND CANADA

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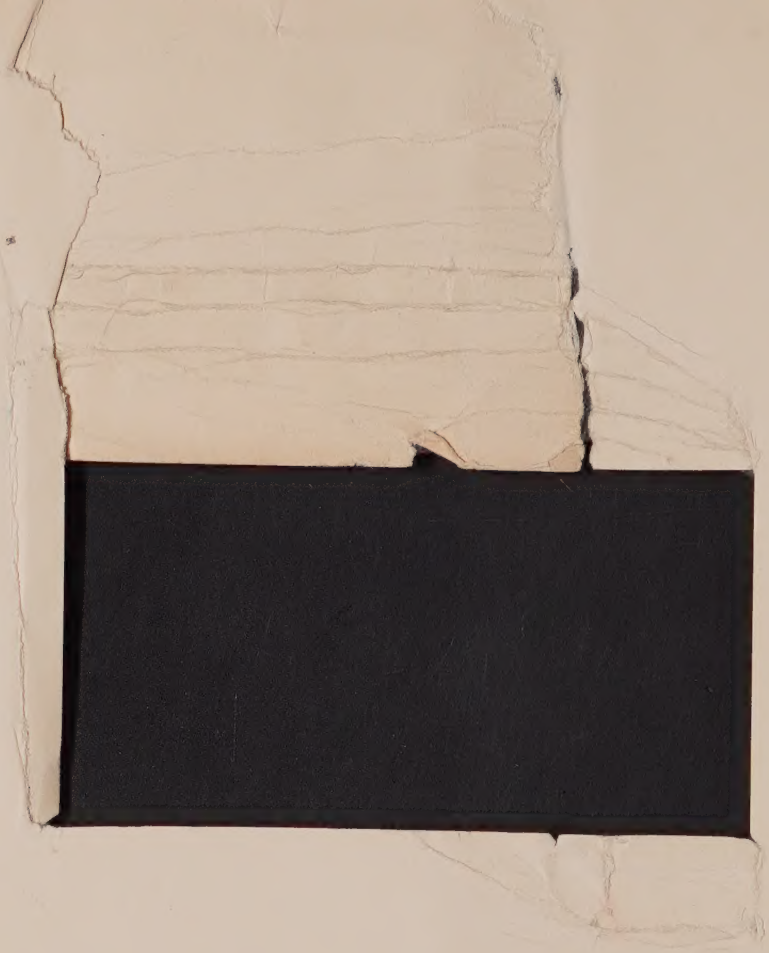

MANUAL

OPERATIONAL - MAINTENANCE

MODEL: TP 2-75 SERIES

Publication No. 1006

NOTICE:

The information contained herein is for the sole purpose of providing the data used in operating and maintaining the above-captioned power supplies and may not be used for any other purpose, or reproduced in any form, either in whole or in part, without the written consent of Behlman-Invar Electronics Corporation.

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TABLE OF CONTENTS

SECTION			PAGE
I	Introduction and Description		1
	1-1	General	1
	1-2	Purpose	1
	1-3	Warranty	1
	1-4	Preparation for Use and Reshipment	2
	1-5	Quality Control and Inspection	3
	1-6	Safety Notes	3
	1-7	Electrical Specifications	4
	1-8	Environmental Specifications	5
	1-9	Mechanical Specifications	5
	1-10	Applicable Documents	6
II	Principles of Operation and Instruction		7
	2-1	Design Objective	7
	2-2	Circuit Theory of Operation	7
	2-3	Internal Reference Supply	9
	2-4	Auxiliary Supply	9
	2-5	Short Circuit Protection	9
	2-6	Controls	10
	2-7	Operational Procedures	10
III	Maintenance Procedures		11
	3-1	Maintenance and Trouble Shooting	11
	3-2	Trouble Shooting Procedures	11
APPENDIX			15

LIST OF ILLUSTRATIONS

TABLE PAGE

1-1 Electrical Specifications 4
1-2 Mechanical Specifications..... 5
3-3 Test Voltage Chart..... 13

FIGURE

2-1 Functional Block Diagram 8
A-1 Schematic .....Appendix

SECTION I

INTRODUCTION AND DESCRIPTION

1-1. GENERAL.

Behlman-Invar Electronics Corporation, who have pioneered many of the more important advancements in the field of transistorized power supplies, are pleased to submit this instruction manual for the model TP 2-75 Series power supply unit.

This model is a precision transistorized power supply which operates from 115 volts ac at 60 cps line voltage (with the exception of the "B" model which incorporates an autoformer T4 to permit 230v ac at 50 cps line input, all other conditions being typical) and delivers a precisely regulated dc output. (See Paragraph 1-7, Electrical Specifications.) The unit may be used in the laboratory or incorporated in other electronic equipment as a source of high quality, fully regulated dc power.

1-2. PURPOSE.

To provide a power supply under design criteria conforming to the latest state of the art.

To provide an operational and instruction manual containing complete information for assistance when using the units.

1-3. WARRANTY.

Seller warrants the end product of its design and construction to be free from defects in material and workmanship. Any component parts other than vacuum tubes, fuses, blower motors, indicating lamps and other indicating devices (except as warranties on these items are passed on to the seller by its suppliers), which become defective during the first year after shipment will be replaced free of charge by the seller, provided that the instrument is returned with transportation charges prepaid by the original purchaser and that our examination discloses to our satisfaction that the instrument is defective, but if the apparatus is installed, or its installation supervised, by the seller, said year

shall run from the completion of the installation, provided that same is not unreasonably delayed by the buyer.

The condition of any tests shall be mutually agreed upon, and the seller shall be notified, and may be represented at, all tests that may be made. The liability of the seller to the buyer (except as to title) arising out of the supplying of the said apparatus, or its use, whether on warrant, contract, or otherwise, shall not in any case exceed the cost of correcting defects in the apparatus as herein provided, and upon the expiration of said year all such liability shall terminate.

The foregoing shall constitute the sole remedy of the buyer, and the sole liability of the seller.

1-4. PREPARATION FOR USE AND RESHIPMENT.

Unpack the instrument with care and inspect it for any damage which it may have incurred in transit. If there is any damage, or if the unit fails to operate properly in accordance to instructions (See Paragraph 2-7), a claim should be filed with the carrier, with a copy of the Claim Agent's report being forwarded to Behlman-Invar Electronics Corporation.

NOTE:

DO NOT RETURN THE INSTRUMENT
TO THE FACTORY WITHOUT PRIOR
AUTHORIZATION FROM BEHLMAN-
INVAR ELECTRONICS CORPORATION.

On packaging for reshipment use adequate shock-absorbent material within the carton to prevent the instrument's sharp corners from protruding which would result in unit damage.

1-5. QUALITY CONTROL AND INSPECTION.

Behlman-Invar Electronics Corporation functions under a company-wide quality assurance program which insures that our customer receives equipment manufactured to the most exacting standards. This quality assurance system is based on the best commercial practices augmented by policies and procedures required under MIL Q-9858.

1-6. SAFETY NOTES.

WARNING

Operation of the Behlman-Invar power supplies involves the use of high voltage. Use EXTREME CAUTION when any internal adjustments or tests are being performed.

CAUTION

When remote sensing is not used, VERIFY that the REMOTE SENSE shorting jumpers are correspondingly installed on the minus and plus remote sense terminals located on the chassis rear to avoid damaging the unit. (See Schematic, Figure A-1.)

1-7. ELECTRICAL SPECIFICATIONS.

The following tabulation lists the electrical characteristics for the TP Series power supplies, Model TP 2-75 Series.

	Output dc		Regulation	Ripple	Output Z		Transients	
Model	E (v dc)	I (amps)	No load Line to full load	mV rms max	ohms dc	ohms 100 kc	±10% Line	Recovery time no load to full load μsec. max.
TP-275	0-75	2	20 10	1.0	0.002	0.1	None	20

TABLE 1-1.

Input Line Voltage: 115v ac at 60 cps, single phase for TP 2-75.
230v ac at 50 cps, single phase for TP 2-75B.

Remote Sensing: Remote sensing is provided so that the selected output potential is maintained across a remote load despite a nominal line drop (due to their length) in the interconnecting cables.

Short Circuit Protection: Unit is capable of being shorted continuously without damage. Turning on the unit while the output or remote load is shorted causes no damage, and when the short is removed the voltage and current return to preset values.

1-8. ENVIRONMENTAL SPECIFICATIONS.

F1: Fuse, 2 amp, located on the rear of the chassis and inserted in the ac input to the supply.

F2: Fuse, 3 amp, on TP2-75 and 2 amp for the "B" model, located on the rear of the chassis and inserted in the ac input to the supply.

Operating Temperature: 0° to 50° C.

1-9. MECHANICAL SPECIFICATIONS.

Width	Height	Depth	Weight
19"	5-1/4"	13"	40

TABLE 1-2

Mounting:	All units may be mounted on a standard 19" relay rack panel.
Terminals:	Front and rear-mounted terminals are incorporated which provide ac input, dc output and remote sensing. (For functions see Schematic, Figure A-1.)

1-10. APPLICABLE DOCUMENTS.

Design Control:	Behlman-Invar 007-0099 - TP 2-75. Behlman-Invar 007B-0099 - TP 2-75B

SECTION II

PRINCIPLES OF OPERATION AND INSTRUCTION

2-1. DESIGN OBJECTIVE.

The design parameters of the Model TP Series power supply contribute to their operation in the following manner:

a. Provide a dc power supply fully regulated that is variable from 0 to 75 as specified in the electrical specifications. (See Paragraph 1-7.)

b. Provide a high efficiency operation by allowing only a minimum of internal wattage dissipation regardless of output load conditions.

c. Provide fully rectified, filtered and stabilized voltage for the regulation circuitry, transformer section, filter section, and Zener diode section.

d. Provide a remote sensing function, permitting the output voltage to be regulated from the voltage sensed at the load end. This feature ensures that the output voltage at the load remains constant, within the regulation specifications, with a nominal line drop.

2-2. CIRCUIT THEORY OF OPERATION.

The input ac is supplied from J1, Pins 2 and 3, through S1 to T4 autoformer and DS1 and blower to T1 and T3, the auto and auxiliary transformers, respectively for the TP 2-75B model; on the TP 2-75 delete the autoformer T4.

The ac from T1 passes through Fuse F1 to T2, the step-down power transformer of the raw dc section of the power supply where the output of T1 is applied to the rectifier CR1 and CRX and then filtered through the network of C1-1 and C1-2.

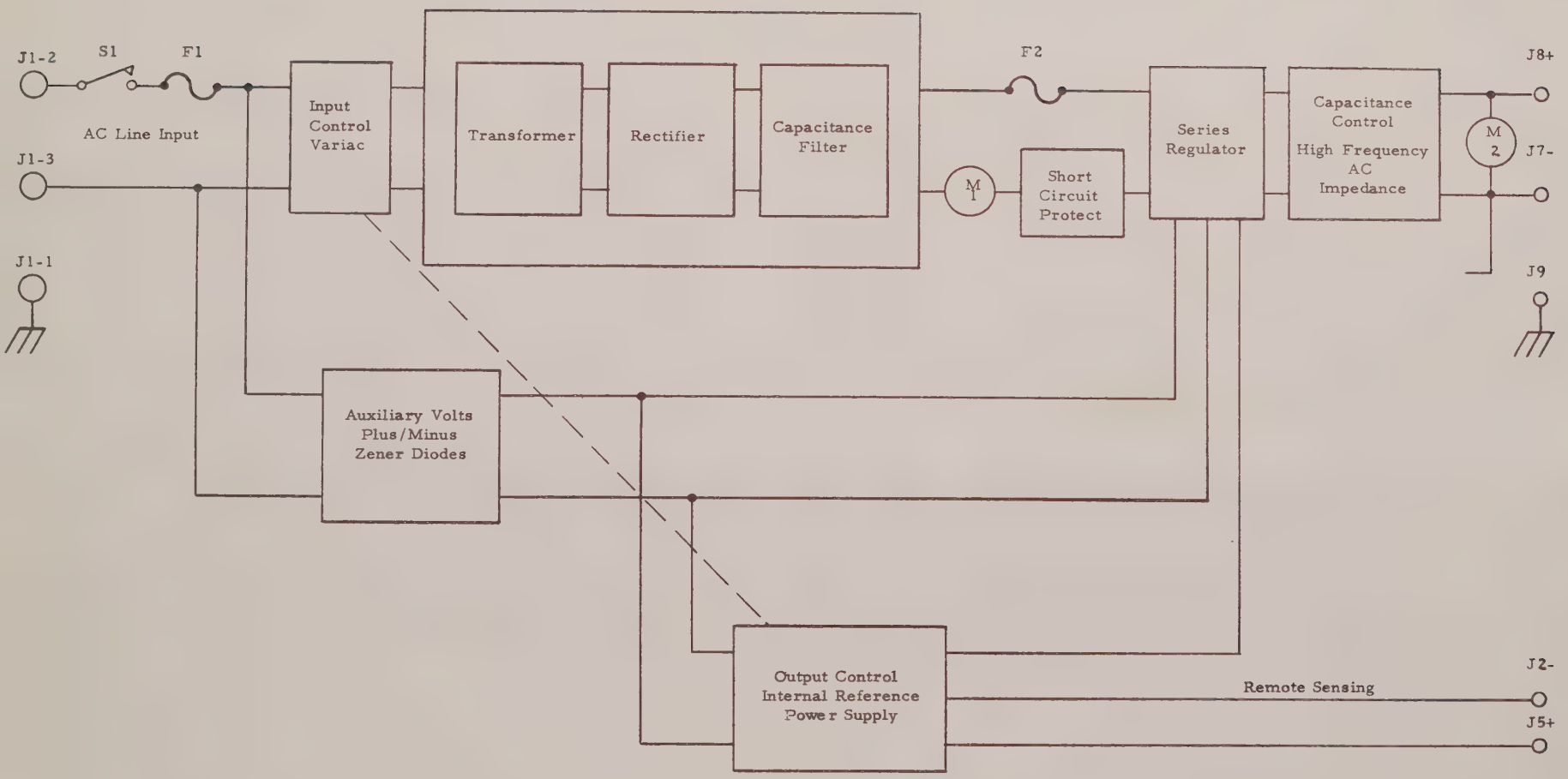

FIGURE 2-1. TP SERIES FUNCTIONAL BLOCK DIAGRAM

The raw dc is then fed through F2 being applied to the series regulator pass transistors Q13-1 through Q13-2 and then to Q10-1 and Q10-2, whose bases are driven by the power driver Q9 and the small signal Q8, whose bases are in turn being driven by the balanced amplifiers Q6 and Q7. Q13 and Q10 are in series to protect against high voltage drop in short circuit.

The power supply output voltage is sensed at the base of Q7 by the divider network R33 and R40 and compared with a very stable reference voltage developed across R27, the output coarse voltage control, and R26, the output fine voltage control.

2-3. INTERNAL REFERENCE SUPPLY.

The internal reference supply section, consisting in part by the transistors Q2, Q3, Q4 and Q5, and Zener reference diode CR12, is essentially in itself a small regulated dc supply, whose purpose is to furnish a highly regulated comparison voltage to the base of Q6.

2-4. AUXILIARY SUPPLY.

Raw dc being furnished to the internal reference supply (see Paragraph 2-3) is obtained from the auxiliary supply section and fed from Transformer T3 to the rectifiers CR5 through CR8, then passing through the filtering network of R1, R2, C2 and C3. Zener diode CR9 furnishes the minus output voltage and CR10 furnishes the plus output voltage for the auxiliary supply.

2-5. SHORT CIRCUIT PROTECTION.

The maximum output current adjust section and short circuit protection consist of Transistor Q1 and Potentiometer R17.

A reference voltage of approximately one volt is established at the emitter of Q1 by the diode CR11 and the dropping resistors R7 and R8. As the current increases through R17 a voltage drop occurs which is tied to the base of Q1 through the potentiometer R16. As this voltage reaches and exceeds the emitter reference voltages, Q1 is turned on. The collector of Q1 is tied through R11 to the base of the small signal driver Q8, thus when Q1 is turned on Q8's base is grounded and current decreases.

In order to obtain the current cutback feature of our short circuit protection the reference voltages of the emitter of Q1 is lowered as the output voltage drops in short circuit and requires less current through R17 to maintain cut-off in the pass transistor.

2-6. CONTROLS.

a. OUTPUT VOLTAGE COARSE, ganged mechanically with R7, R27, and T1, auto transformer, located on the front panel.

b. OUTPUT VOLTAGE FINE, for R26, located on the front panel.

c. MAXIMUM CURRENT ADJUST, for R17, located on the front panel.

d. J1, power input Jones plug, located on the rear of the chassis.

e. S1, toggle switch for ac line input, located on the front panel.

f. DS1, amber "AC ON" indicator light, located on the front panel.

g. M1, 0 to 3 ammeter, located on the front panel.

h. M2, 0 to 100vdc voltmeter, located on the front panel.

i. Plus/minus dc output, chassis ground, also plus/minus remote sense terminals. (For function see Schematic, Figure A-1.)

j. Plus/minus dc output terminals and chassis ground, located on the front panel. (For function see Schematic, Figure A-1.)

2-7. OPERATIONAL PROCEDURES.

a. CONNECT: AC line to J1.

b. ACTIVATE: S1 to the "ON" position.

c. MONITOR: DS1 for "ON" indication.

d. ADJUST: Fine and coarse output voltage controls for the desired voltage.

e. ADJUST: Maximum current control for the desired current flow.

f. MONITOR: M1 and M2 for the desired readings.

SECTION III

MAINTENANCE PROCEDURES

3-1. MAINTENANCE AND TROUBLE SHOOTING.

The power supply does not require any periodic maintenance other than cleaning to remove excessive dust and dirt. If it is necessary to replace components, use only first quality commercial components of values and types indicated. No selected components are used. When replacing components or trouble shooting, observe "warning" (See Warning Notice, Paragraph 1-6) since dangerous voltages may exist in the power supply. If it is ever necessary to replace the variable autotransformer or either of the two potentiometers connected to the variable autotransformer by means of the gear chain, the following check should be used to insure that the gearing is correct. With the coarse output voltage control turned completely counterclockwise, the variable autotransformer T1 and the potentiometers R7 and R27 should be positioned in the same manner.

3-2. TROUBLE SHOOTING PROCEDURES.

a. SYMPTOM: No output voltage.
POSSIBLE CAUSE: Fuse blown.
REPAIR PROCEDURE: Check for damaged rectifiers or shorted input capacitors or transformer, before replacing ac fuse. If dc fuse is blown, then check for possibility of overheating and short circuit. Remove short circuit.

b. SYMPTOM: Poor load regulation.
POSSIBLE CAUSE: Maximum output current adjust potentiometer set at too low a value.
REPAIR PROCEDURE: Set potentiometer to proper maximum current setting. This is about 20% higher than the desired maximum current.

c. SYMPTOM: Poor regulation and output cannot be reduced to zero by output voltage control.

POSSIBLE CAUSE: One of the series regulating transistors, Q10-1 or Q10-2 on the heatsink, or Q9, on the board next to the heatsink, or Q2, on the main component board, is shorted.

REPAIR PROCEDURE: Replace transistor. To determine which transistor is shorted, open the emitter of Q8. If the output voltage drops to zero (without load), transistor Q8 should be replaced.

d. SYMPTOM: Power transformer and variable autotransformer overheated.

POSSIBLE CAUSE: One or more of the rectifiers CR1 to CR4 are defective.

REPAIR PROCEDURE: Replace rectifier.

e. SYMPTOM: Output voltage floats erratically.

POSSIBLE CAUSE: Remote sensing jumpers not tightly connected, or, if remote sensing is being used, remote sensing leads not properly connected.

REPAIR PROCEDURE: Check sensing connections.

From Component	To	Measurement at Full Load
R1	Plus Output	-110v
R2	Plus Output	-56v
+C4	Plus Output	+110v
CR10	Plus Output	+56v
R12	Plus Output	-0.6v
R24	Plus Output	-50v

TABLE 3-3, Test Voltage Chart

All measurements to be taken at full load and by use of a meter rated at 1000 ohms or better.

APPENDIX

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